Figure 4.8.41. Distribution of Trichloroethylene in the Unconfined Aquifer in the 200-West Area, 1996

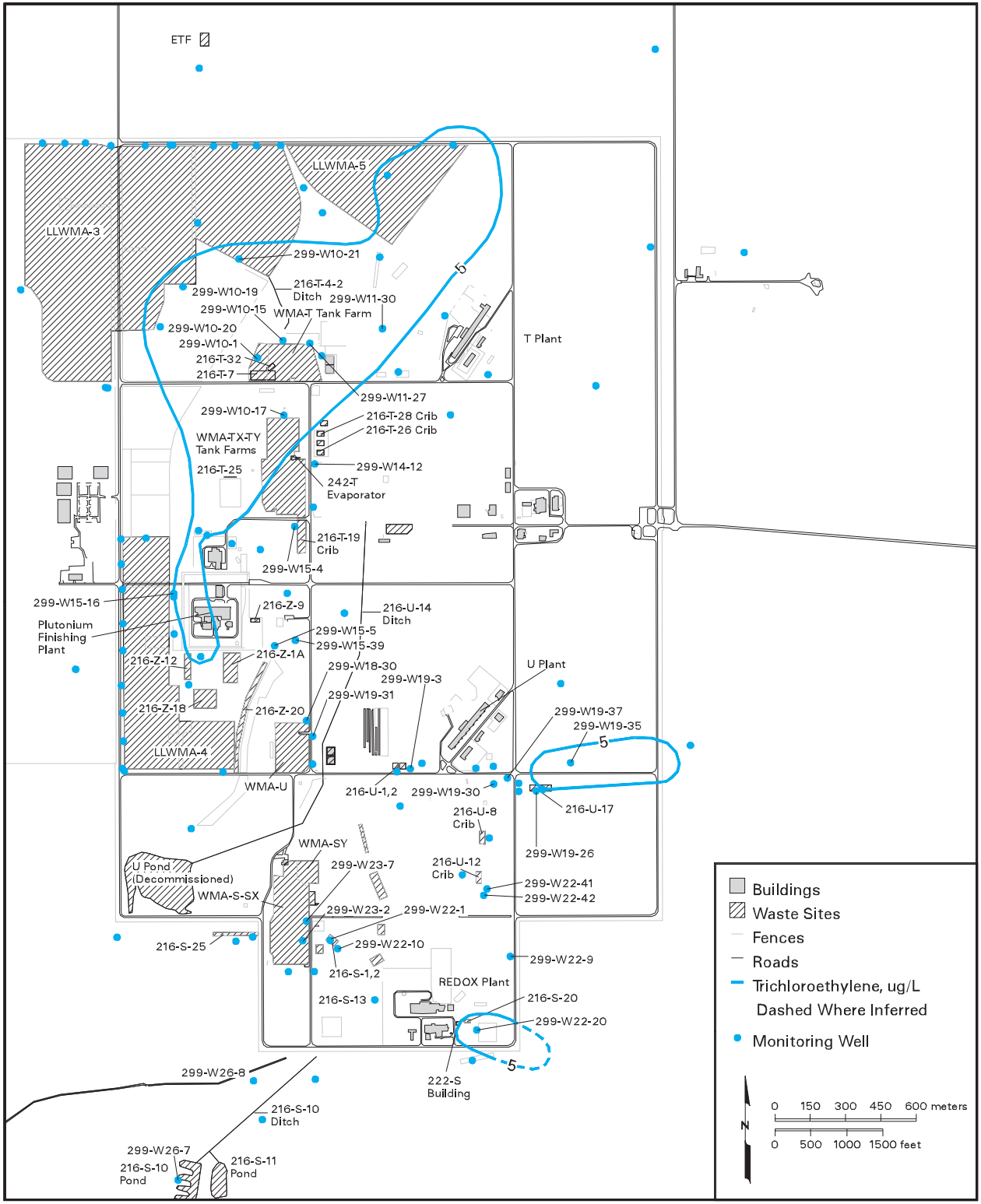

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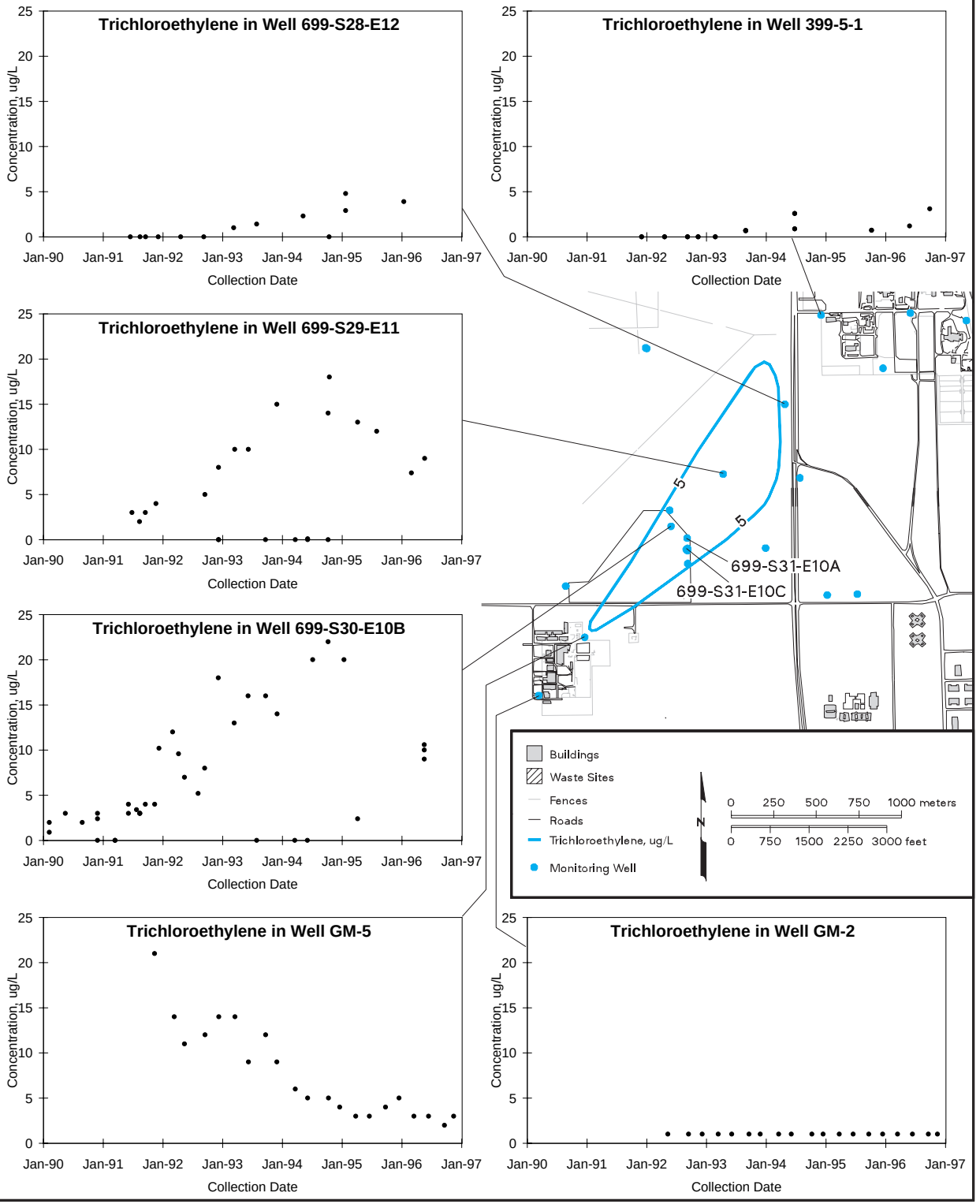
Figure 4.8.42. Distribution of Trichloroethylene in the Vicinity of the Horn Rapids Landfill and Richland North Area, 1996, and Concentration Trends for Select Wells


Trichloroethylene in Well 699-S28-E12
Trichloroethylene in Well 399-5-1
Trichloroethylene in Well 699-S29-E11
Trichloroethylene in Well 699-S30-E10B
Trichloroethylene in Well GM-5
Trichloroethylene in Well GM-2
Concentration, ug/L
Collection Date
0
5
10
15
20
25
Jan-90
Jan-91
Jan-92
Jan-93
Jan-94
Jan-95
Jan-96
Jan-97
699-S31-E10A
699-S31-E10C
Buildings
Waste Sites
Fences
Roads
Trichloroethylene, ug/L
Monitoring Well
N
0 250 500 750 1000 meters
0 750 1500 2250 3000 feet

above the 70-µg/L drinking water standard. In 1996, 140 µg/L of cis-1,2-dichloroethylene were detected in well 399-1-16B. cis-1,2-dichloroethylene is a biodegradation product of trichloroethylene.

Radiological and Chemical Monitoring Results for the Basalt-Confined Aquifer

Aquifers confined below the uppermost basalt layers show much less impact from Hanford Site contamination than the unconfined aquifer system within the overlying sediments. The minor contamination found in the basalt-confined aquifers may be attributed to several factors. These factors include areas where the confining layers of basalt have been eroded away, areas where disposal of large amounts of water resulted in downward gradients, and areas where wells penetrating to the confined aquifers provided pathways for contaminant migration. These factors produced intercommunication between the aquifers, meaning they permitted the flow of groundwater from the unconfined aquifer to the underlying confined aquifer, thereby increasing the potential to spread contamination. Because fewer wells are available to evaluate contamination in the confined aquifer, it is important to consider contamination in the confined aquifer even where the levels are well below drinking water standards. The extents of tritium and other detected contaminants in the uppermost confined aquifer are shown in Figure 4.8.43.

Intercommunication between the unconfined and basalt-confined aquifers in the vicinity of the northern part of the 200-East Area has been identified previously by Gephart et al. (1979) and Graham et al. (1984). Spane and Webber (1995) evaluated the hydrochemical and hydrogeologic conditions within the upper basalt-confined aquifer system and evaluated the potential for offsite migration of contaminants through confined aquifer pathways.

Spane and Webber (1995) identified several confined aquifer wells north and east of the 200-East Area that show evidence of intercommunication with the overlying unconfined aquifer. Intercommunication between the unconfined and confined aquifers in the area north and east of the 200-East Area has been attributed to erosion of the upper Saddle Mountains Basalt and downward vertical gradients resulting from groundwater mounding associated with waste disposal. Groundwater chemical data from most confined aquifer wells in other areas of the Hanford Site do not exhibit evidence of contamination, with the exception of wells that were previously open to both the unconfined and confined aquifers, thus providing conduits for the downward transport of contamination.

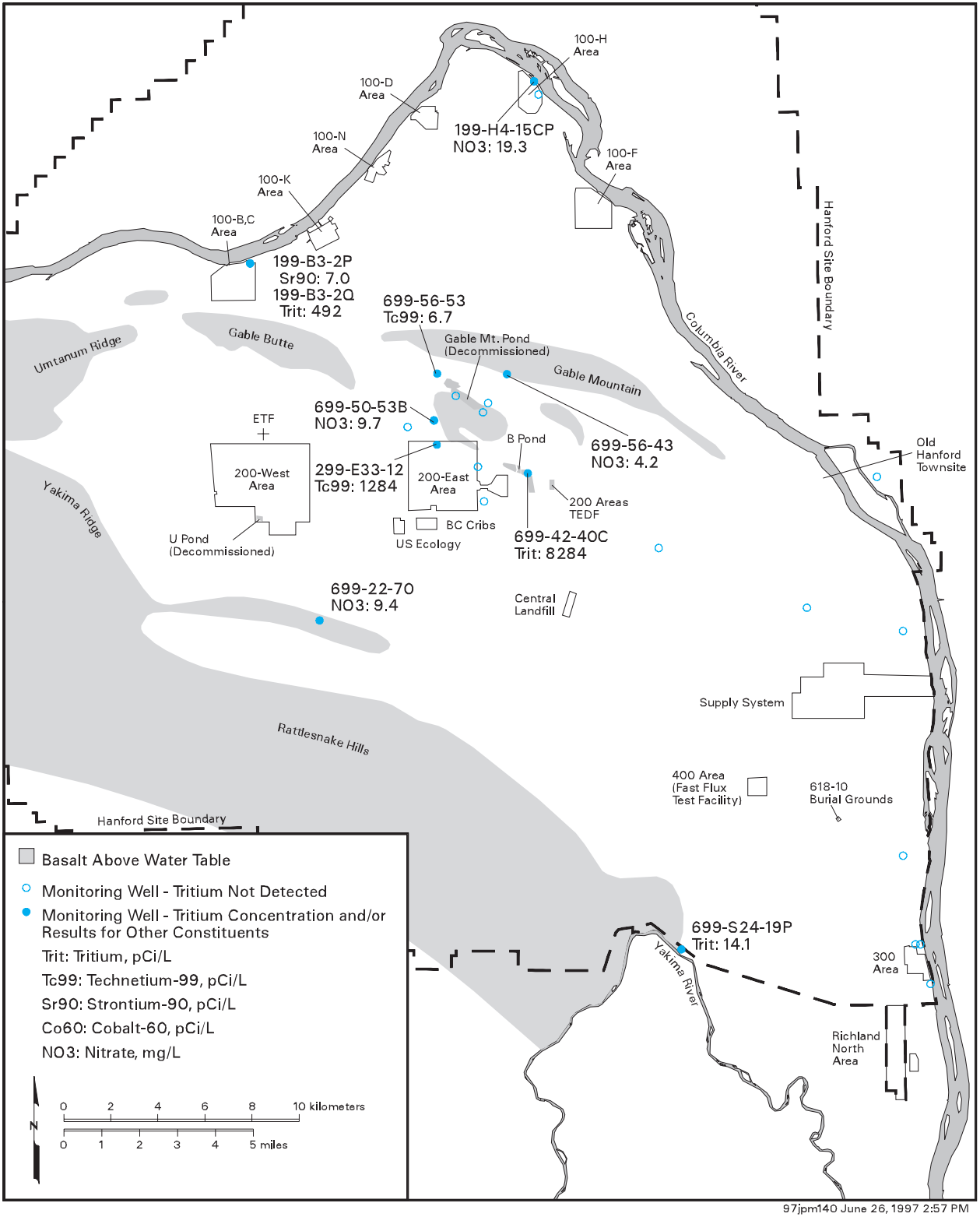
Results of the 1995 sampling and analyses of groundwater from the upper basalt-confined aquifer indicated only a few areas of concern that warranted continued annual monitoring. Consequently, the number of wells sampled during 1996 was reduced to those with groundwater contamination or those downgradient from areas with historical indications of contamination. Prominent analytical results and trends arising from 1996 sampling are discussed below. The locations of wells used for monitoring confined aquifer groundwater chemistry were given in Figure 4.8.10.

Well 199-B3-2P, in the 100-B Area, is currently completed within the confined aquifer but was open to both the confined and unconfined aquifers between 1953 and 1970. This well likely provided a conduit for downward migration of contamination from the unconfined aquifer. The 7.0-pCi/L concentration for strontium-90 measured at this well in 1996 was up from 3.9 pCi/L in 1995. The drinking water standard for strontium-90 is 8 pCi/L. The extent of contamination in the confined aquifer near well 199-B3-2P is unknown.

Contamination has also been identified in the confined aquifer in the northern part of the 200-East Area and adjacent parts of the 600 Area. The highest levels of contamination detected in the confined aquifer in this vicinity were in well 299-E33-12. Contamination in this well is attributed to migration of high-salt waste down the borehole during construction when it was open to both the unconfined and confined aquifers (Graham et al. 1984). During 1996, a technetium-99 concentration of 1,280 pCi/L was detected at well 299-E33-12, which is above the 900-pCi/L drinking water standard. Cobalt-60 was detected during 1995 at 154 pCi/L in the confined aquifer at well 699-49-55B, located north of the 200-East Area. This well was not analyzed for cobalt-60 in 1996. The cobalt-60 contamination at this well may be related to the use of neighboring well 699-49-55A, which is completed in the unconfined aquifer, for injection of water from a pump-and-treat test for groundwater remediation in 1994.

Well 699-42-40C monitors the confined aquifer adjacent to B Pond. Tritium at this well reached a high of 8,320 pCi/L in 1993, the concentration declined until 1995, then began rising again. In 1996, the tritium concentration was 8,284 pCi/L, still well below the

Figure 4.8.43. Tritium and Other Contaminants Detected in Confined Aquifer Wells, 1996



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20,000-pCi/L drinking water standard. The iodine-129 result for 1996 was 0.36 pCi/L, the highest since monitoring began in 1988 but still less than the 1-pCi/L drinking water standard.

Well 299-W15-5 in the 200-West Area is completed in both the unconfined and confined aquifers, where groundwater mounding associated with the decommissioned U Pond has increased the downward vertical gradient and may be a conduit for downward migration of contamination from the unconfined aquifer. Past data for this well indicate that tritium concentrations were as high as 7,000 pCi/L in 1982. The current extent of contamination in the confined aquifer near well 299-W15-5 is unknown.

Wells 699-20-82 and 699-22-70 are completed in the basalt-confined aquifer near the base of the Rattlesnake Hills in an area where pervasive downward flow from the unconfined aquifer recharges the upper portion of the confined aquifer (Spane and Webber 1995). Samples from well 699-22-70 contained up to 9.0 mg/L of nitrate in 1996, well below the 45-mg/L drinking water standard. In past years, samples from well 699-20-82 contained as much as 23.9 mg/L of nitrate. Nitrate in the overlying unconfined aquifer in the Dry Creek Valley area and in wells 699-20-82 and 699-22-70, may result from agricultural sources to the south and west and is not believed to originate from sources on the Hanford Site.

Resource Conservation and Recovery Act Summary

More than 60 treatment, storage, and disposal units are recognized under the Hanford Facility Resource Conservation and Recovery Act permit. Of these, 26 required groundwater monitoring during 1996. Locations of these groundwater monitoring sites were given in Figure 4.8.11. This section provides a summary of groundwater monitoring activities and results for these sites. Additional information on Resource Conservation and Recovery Act groundwater monitoring, including complete listings of radioactive and chemical constituents measured in monitoring wells from October 1995 through September 1996, is available in Hartman and Dresel (1997). Any significant changes in Resource Conservation and Recovery Act groundwater monitoring results that occurred from October through December 1996 are noted below.

Resource Conservation and Recovery Act groundwater monitoring is conducted under one of three phases: 1) indicator parameter/detection, 2) groundwater quality assessment/compliance, or 3) corrective action. Initially, a detection program is developed to monitor the impact of facility operations on groundwater. During the indicator parameter/detection phase, groundwater parameters established for the particular site are measured in wells upgradient and downgradient from the site. Statistical tests are applied to the monitoring results to calculate "critical mean" values for each monitoring parameter. These values represent the background water quality for the site. Subsequent monitoring data are compared to the critical mean values to determine if there has been a statistically significant increase in the concentrations of key indicator parameters or dangerous waste constituents in the groundwater. The statistical methods used to calculate critical means and compare with monitoring data are described in Hartman and Dresel (1997). If a statistically significant difference is observed, then a groundwater quality assessment/compliance phase of monitoring and investigation is initiated. During this phase, groundwater monitoring is designed to determine if groundwater protection standards have been exceeded. If the source of the contaminants is determined to be the treatment, storage, and disposal unit, and concentrations exceed maximum contaminant levels defined in the monitoring plan or permit, then the Washington State Department of Ecology may require corrective action to reduce the contaminant hazards to the public and environment. Groundwater monitoring during the corrective action phase is designed to assess the effectiveness of the corrective action. Table 2.2.2 listed the phase pertaining to each of the Resource Conservation and Recovery Act groundwater monitoring projects at the end of 1996.

100 Areas Facilities

1301-N Liquid Waste Disposal Facility. The 1301-N facility was the primary liquid waste disposal site for N Reactor from 1963 until 1985. Discharges were primarily radioactive fission and activation products. Minor amounts of dangerous waste and other constituents may also have been discharged, including ammonium hydroxide, cadmium, diethylthiourea, hydrazine, lead, morpholine, phosphoric acid, and sodium dichromate. 1301-N consists of a concrete basin with an unlined, zigzagging extension trench, covered with concrete panels.

The indicator parameters of specific conductance, pH, total organic carbon, and total organic halogen measured in downgradient wells remained below the critical mean values at 1301-N during 1996.

1325-N Liquid Waste Disposal Facility. The 1325-N facility was constructed in 1983 and also received

effluent from N Reactor. In 1985, discharge to 1301-N ceased, and all effluent was sent to 1325-N. All discharge to 1325-N ceased in late 1991. The facility consists of a concrete basin with an unlined extension trench, covered with concrete panels.

The indicator parameters of specific conductance, pH, total organic carbon, and total organic halogen in downgradient wells remained below the critical mean values at 1325-N during 1996. Specific conductance in the upgradient well (199-N-74) was elevated in the past, possibly because of the upgradient influence of the 1324-NA Pond. Groundwater at 1325-N and at 1301-N is also analyzed for other constituents that were discharged to these facilities. These include cadmium, chromium, lead, nitrate, and phosphate. Cadmium, lead, and phosphate (in filtered samples) were not detected in 1301-N or 1325-N groundwater in significant concentrations. Nitrate is sporadically detected, but the sources are uncertain.

1324-N and 1324-NA Ponds. The 1324-N Pond was a treatment facility that was in service from May 1986 to November 1988. This facility is a double-lined pond that was used to neutralize high- and low-pH waste from a demineralization plant. 1324-NA is unlined and was used to treat waste from August 1977 to May 1986 and to dispose treated waste from May 1986 to August 1990. The effluent to both facilities contained sulfuric acid and sodium hydroxide, whose pH was occasionally high or low enough to be classified as a dangerous waste.

Specific conductance measured in 1996 in wells downgradient from 1324-N and 1324-NA was higher than the background critical mean value. The increase in this indicator parameter was expected because 1324-NA introduced nondangerous constituents (e.g., sodium and sulfate) to groundwater. Downgradient measurements of pH, total organic carbon, and total organic halogen were below critical mean values in 1996. It was determined that no additional groundwater assessment was warranted for this site.

120-D-1 Ponds. The 120-D-1 Ponds were constructed in 1977 for disposal of nonradioactive effluent derived from operating facilities in the 100-D,DR Area. This facility is located in the former 188-D Ash Disposal Basin and includes settling and percolation ponds separated by a dike. Effluent to the ponds originated from two sources: the 183-D Filter Plant and the 189-D Building engineering testing laboratories. Some past discharges contained hydrochloric acid, sodium hydroxide, and sulfuric acid. Before 1986, the effluent may have had a >12.5 or <2.0 pH and, thus, may have been dangerous waste. There was also a potential for up to 2.3 kg of mercury to have been discharged to the ponds. Effluent discharge ceased in 1994. Between 1986 and 1994, the effluent included chlorine and flocculating agents such as aluminum sulfate. Contaminated soils were removed from the 120-D-1 Ponds in 1996.

At the 120-D-1 Ponds site, samples from wells 199-D8-4 and 199-D8-6 exceeded the critical mean value for pH in February 1996, and verification sampling was conducted in March 1996. Results for well 199-D8-4 were below the critical mean but results for well 199-D8-6 were confirmed to be greater than the critical mean. The Washington State Department of Ecology was promptly notified of the exceedance as required by 40 CFR 265.93(d)(1) and a report describing the results of a groundwater quality assessment at the ponds was prepared and submitted in April 1996 (Hartman 1996a). The report concluded that the elevated pH originated from coal ash under the ponds and not from the ponds themselves. Therefore, the site remains in indicator parameter monitoring.

183-H Solar Evaporation Basins. The 183-H facility, which is now demolished, consisted of four separate concrete basins surrounded by an earthen berm. Between 1973 and 1985, the basins were used to store liquid waste, primarily from nuclear fuel fabrication activities conducted in the 300 Area. Volume reduction occurred by solar evaporation. The waste was predominantly acid etch solution that had been neutralized with sodium hydroxide before being discharged into the basins. The solutions included chromic, hydrofluoric, nitric, and sulfuric acids and also contained various metallic and radioactive constituents.

Groundwater in the vicinity of the 183-H basins is characterized by elevated levels of chromium, nitrate, sodium, sulfate, technetium-99, and uranium. All of these constituents were present in waste discharged to the basins when they were in use. The Resource Conservation and Recovery Act groundwater monitoring plan for these basins (Hartman and Chou 1995) identifies four contaminants of concern (waste indicators) for statistical evaluations under WAC 173-303-645(10): chromium, nitrate, technetium-99, and uranium. The concentrations of the waste indicators typically are highest in well 199-H4-3, located immediately downgradient of the basins. Although the concentrations decreased several orders of magnitude in this well since the basins ceased operation, they remained above drinking water standards for most of the past year.

In 1986, the Washington State Department of Ecology issued a compliance order that placed the 183-H basins into interim-status assessment monitoring. The basins were incorporated into the Hanford Site Resource Conservation and Recovery Act permit in September 1994 and became subject to final-status monitoring.

Results of the September through December 1995 sampling event indicated that concentration limits for chromium, nitrate, technetium-99, and uranium were exceeded in one or more downgradient wells. Confirmation sampling was conducted in the spring of 1996. Some of the samples confirmed the presence of contamination at levels above regulatory limits. The Washington State Department of Ecology was notified of the exceedances, which normally initiates a corrective action program. The 183-H basins are part of the 100-HR-1 and 100-HR-3 Operable Units, so corrective action was deferred and will be completed under the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act. In the interim, Resource Conservation and Recovery Act monitoring will continue under the current program.

The 183-H basins monitoring program is adequate under current flow conditions. However, a planned pump-and-treat system will extract groundwater from five wells around the basins, including two of the Resource Conservation and Recovery Act wells. The adequacy of the monitoring network will be evaluated in the coming year.

200 Areas Single-Shell Tank Farms

Single-shell tanks are located in the A-AX, B-BX-BY, C, S-SX, T, TX-TY, and U Tank Farms and have been designated as Resource Conservation and Recovery Act facilities. The single-shell tanks store a mixture of dangerous chemical and radioactive wastes generated by reprocessing fuel irradiated in Hanford reactors. The single-shell tanks received mixtures of organic and inorganic liquids containing radionuclides, solvents, and metals that were originally discharged to the tanks as alkaline slurries. Subsequent waste management operations have mixed waste streams from different processes. In many tanks, wastes have been concentrated by removing water vapor.

A-AX Tank Farms. Critical mean values of the indicator parameters specific conductance, pH, total organic carbon, and total organic halogen were not exceeded during 1996. For iodine-129, all wells show concentration values above the drinking water standard because of a plume extending through this area from other sources. Tritium levels have been historically greater in one upgradient well versus downgradient wells at these tank farms.

B-BX-BY Tank Farms. The indicator parameter of specific conductance has been increasing in downgradient wells since monitoring began in 1990 and exceeded the critical mean value in well 299-E33-32 in February 1996 and in subsequent verification sampling. The rise in specific conductance appears to be related to an increase in nitrate and chloride. Several other downgradient wells have displayed trends of increasing nitrate and chloride with corresponding increases in specific conductance since 1992. There were no exceedances of critical means for the indicator parameters pH, total organic carbon, or total organic halogen during 1996. Iodine-129 levels in the groundwater at the B-BX-BY Tank Farms were above the drinking water standard because of a plume extending through this area from other sources.

C Tank Farm. Critical mean values of the indicator parameters specific conductance, pH, total organic carbon, and total organic halogen were not exceeded during 1996. For iodine-129, all wells showed concentrations above the drinking water standard because of a plume extending through this area from other sources.

S-SX Tank Farms. As discussed in Section 3.3, "Vadose Zone Characterization and Monitoring," spectral gamma logging in the vadose zone at the S-SX Tank Farms in 1996 indicated the presence of cesium-137 at depths ranging from 18 to 37 m (59 to 121 ft). Because the logging results indicated a possible faster-than-expected migration of cesium-137 from known tank leaks and because of elevated concentrations of technetium-99 in groundwater beneath the SX Tank Farm, which may also have resulted from tank leaks, a groundwater quality assessment phase groundwater monitoring program was initiated and an assessment groundwater monitoring plan (Caggiano 1996) was prepared and submitted to the Washington State Department of Ecology. Results for indicator parameters at the S-SX Tank Farms are discussed below:

pH. Field pH measurements for all wells ranged from 7.9 to 8.1, with the upgradient and downgradient wells exhibiting the same range. The critical mean values of 6.68 and 9.18 were not exceeded.

Specific Conductance. If values from the initial four quarters for both upgradient wells 299-W23-13 and 299-W23-14 are used, then the critical mean for specific

conductance was not exceeded. However, using only the southernmost upgradient well (299-W23-14) results in a lower critical mean that was exceeded in three downgradient wells during 1996. The cause of elevated specific conductance is being addressed by the assessment groundwater monitoring plan (Caggiano 1996).

Total Organic Carbon. Reported values for total organic carbon did not exceed the critical mean value.

Total Organic Halogen. Concentrations of total organic halogen exceeded the critical mean value at both upgradient and downgradient wells at the S-SX Tank Farms. The increasing total organic halogen concentrations are attributed to the southward and eastward migration of the carbon tetrachloride plume resulting from historical discharge activities at the Plutonium Finishing Plant. Because increasing concentrations are seen in upgradient wells, the increased halogen is not suspected to be from the S-SX Tank Farms.

Technetium-99 and Total Beta. As late as 1994, technetium-99 was found above the interim drinking water standard in a plume extending southeasterly from the vicinity of the S-SX Tank Farms. Since that time, measured concentrations have declined to less than the interim drinking water standard for all samples from this plume. The highest technetium-99 concentrations are found near the eastern half of the S-SX Tank Farms and near the 216-S-1 and 216-S-2 Cribs. The technetium-99 plume extends to the southeast, and can be detected beyond the 200-West Area boundary. Technetium-99 was generally not measured in groundwater samples before approximately 1986. However, measurements of total beta radiation correlate with the concentration of technetium-99 because it is a beta-emitting radionuclide. Total beta measurements indicate that peak technetium-99 concentrations in the vicinity of the S-SX Tank Farms probably occurred during the late 1980s at well 299-W23-2, which is just east of the tank farms (Hartman and Dresel 1997).

This technetium-99 plume was previously thought to be from discharge to nearby cribs. However, an examination of the ratios of technetium-to-uranium concentration provided evidence that tank waste liquids may be the source. A large area under the eastern portion of the S-SX Tank Farms is underlain by groundwater with technetium-99-to-uranium ratios that are >50. These relatively high ratios indicate that the tanks may be the source because the ratio of technetium-99-to-uranium concentration in tank waste liquids is generally high (>300) and the ratio in waste disposed to cribs is generally low (<0.1). In addition, the area with high technetium-99-to-uranium ratios tended to have relatively high technetium-99 concentrations and low tritium concentrations. Tritium is removed from the tank waste by evaporation. Condensate from this evaporation process is disposed in the adjacent cribs, thus enriching the discharge to the cribs with tritium (Hartman and Dresel 1997). The source of technetium-99 is being further evaluated under the assessment groundwater monitoring plan for the S-SX Tank Farms (Caggiano 1996).

Cesium-137. One sample collected in 1994 from well 299-W23-7, located on the eastern edge of the S-SX Tank Farms, contained 22 pCi/L of cesium-137. The same well showed a cesium-137 concentration of 18 pCi/L in 1996. These values are well below the 200-pCi/L drinking water standard. However, no cesium-137 was expected in the groundwater at this location. Although cesium-137 is known to have been released from tank leaks, it was not expected to be found at water-table depth, approximately 50 m (162 ft) below the bottom of the waste tanks, because its movement through the soil column is slowed by chemical sorption processes. Cesium-137 may have migrated to the water table through the well bore or well annulus at this location. However, because spectral-gamma logging within the vadose zone at the S-SX Tank Farms indicated a possible faster-than-expected migration of cesium-137 from known tank leaks, the presence of cesium-137 at well 299-W23-7 is being investigated as part of the S-SX Tank Farms' assessment monitoring program.

T and TX-TY Tank Farms. In November 1992, the critical mean for field specific conductance was exceeded in downgradient wells 299-10-15 (at the T Tank Farm) and 299-W10-17 and 299-W14-12 (at the TX-TY Tank Farms). Verification sampling placed these two sites into the groundwater quality assessment phase of monitoring. Quarterly sampling along with historic trends and waste management data identified calcium, chloride, magnesium, and nitrate as the primary constituents contributing to the elevated specific conductance. Elevated nitrate is widespread in the groundwater in the northern part of the 200-West Area (see Figure 4.8.35) because of the discharge of large amounts of nitrate to nearby trenches and cribs in the mid-1950s. The current assessment study of the T and TX-TY Tank Farms is attempting to differentiate contamination emanating from nearby trenches and cribs from that which may have leaked from waste tanks.

A number of other constituents exceeded regulatory limits in the vicinity of these tank farms. These include carbon tetrachloride, filtered chromium, filtered iron, fluoride, iodine-129, nickel, nitrate, technetium-99, and tritium. Some of these contaminants follow the same historical trend as nitrate, indicating a source more extensive than these tank farms. At the T Tank Farm, well 299-W11-27 showed large increases in several chemical species, including specific conductance, nitrate, technetium-99, and tritium that diverge from trends in nearby wells.

Tritium. A tritium plume that covers much of the northern half of the 200-West Area has its highest concentrations near the TX-TY Tank Farms and associated cribs (see Figure 4.8.12). The maximum average annual tritium detected in this plume in 1996 was 120,000 pCi/L in well 299-W15-4. The plume extends northeast, beyond the 200-West Area boundary. An area north of the T Tank Farm consistently shows tritium at levels much lower than the surroundings. The reason for this is unclear but may be related to discharge of relatively clean water to the 216-T-4 Ditch (Alexander et al. 1995). Concentrations of tritium and other constituents are increasing rapidly at well 299-W11-27 in the southern portion of this less-contaminated zone. The tritium concentration increased from approximately 1,200 to 12,000 pCi/L at this well during 1996.

Technetium-99. The area of the technetium-99 plume above the interim 900-pCi/L drinking water standard is restricted to the immediate vicinity of the TX-TY Tank Farms and the northeastern corner of the T Tank Farm. The maximum average annual technetium-99 detected near the TX-TY Tank Farms in 1996 was 1,200 pCi/L at well 299-W14-12. The technetium-99 concentration at this well, like the tritium concentration discussed above, declined in 1996. At the T Tank Farm, technetium-99 increased sharply at well 299-W11-27 to 19,500 pCi/L (see Figure 4.8.31). Total beta concentrations also showed a corresponding increase. No similar increases were seen at upgradient or other downgradient wells for this tank farm. These data are being evaluated as possible evidence of groundwater contamination from past T Tank Farm leaks.

Iodine-129. The extent of iodine-129 at concentrations above the interim 1.0-pCi/L drinking water standard in the T Plant area coincides with the tritium and technetium-99 plumes (see Figure 4.8.22). The maximum concentration of iodine-129 detected in this vicinity during 1996 was 6.8 pCi/L in well 299-W14-12. The iodine-129 concentration in this well declined in a manner similar to that of tritium and technetium-99. Iodine-129 was not measured in well 299-W11-27 during 1996.

Uranium. Few analyses for uranium were performed in the vicinity of T Plant in 1996 because most wells showed insignificant levels in previous monitoring. Wells monitored near the single-shell tanks for Resource Conservation and Recovery Act compliance were sampled for total alpha measurements, which would show an increase if uranium contamination appeared.

Nitrate. Much of the northern part of the 200-West Area continued to contain nitrate at concentrations in excess of the 45-mg/L drinking water standard (see Figure 4.8.35). During 1996, nitrate ranged up to 1,100 mg/L in well 299-W10-1, which is located west of the T Tank Farm near the 216-T-7 and 216-T-32 Cribs. A large quantity of nitrate was discharged in this area during the 1940s and 1950s. Nitrate was also found at elevated levels farther south near the TX-TY Tank Farms. The area of low nitrate north of the T Tank Farm corresponds to the area of low concentration of other constituents discussed above. The nitrate concentration at well 299-W11-27 increased from approximately 27 to 230 mg/L during 1996, which coincided with the increases in tritium and technetium-99 at this well.

Chromium. Chromium contamination continues to be found above the 50-mg/L state drinking water standard and the 100-mg/L federal drinking water standard in the T Plant area. Chromium was above the drinking water standard in filtered samples from the area north and west of the T Tank Farm, where the maximum average annual concentration detected in 1996 was 306 mg/L at well 299-W11-27. Chromium concentrations decreased to less than 100 mg/L at this well during 1996 and did not follow the same increasing trend as nitrate, technetium-99, and tritium. Chromium was also above the drinking water standard in well 299-W14-12, located east of the TX-TY Tank Farms, though at lower levels than in 1995.

U Tank Farm. This single-shell tank farm is currently under a detection-level monitoring program. There were several critical mean exceedances for contamination indicator parameters pH and total organic halogen during the year. However, given the changes in groundwater flow directions and resultant uncertainty in upgradient-downgradient distinctions, the meaning of the exceedances is somewhat uncertain.

pH. The field pH upper critical mean value of 8.59 was exceeded in well 299-W19-31 in February 1996 with a

value of 8.7 and in May 1996 with a value of 8.8. These exceedances were apparently the result of some changing groundwater flow directions. They were of short duration and do not appear to be significant.

Total Organic Halogen. Total organic halogen values ranged from 25 to 416 mg/L for 1996. There was a general increase in total organic halogen values across the U Tank Farm. The 416-mg/L value reported for August 1996 at well 299-W18-30 exceeded the critical mean value of 241 mg/L. The increasing total organic halogen values are probably a result of spreading of the carbon tetrachloride plume from the Plutonium Finishing Plant (Hartman and Dresel 1997). The U Tank Farm monitoring network, completed in 1993, was based on a west-to-east groundwater flow direction. A reversal in the direction of groundwater flow between mid-1993 and late 1995 resulted in flow toward the northwest, which rendered both upgradient and downgradient coverage inadequate. However, by the time this reversal was recognized, groundwater flow had returned toward the southeast. Under current flow conditions, some downgradient wells at the U Tank Farm may be impacted by the carbon tetrachloride plume from the Plutonium Finishing Plant prior to its being detected in the upgradient wells.

Technetium-99. There was a significant increase in technetium-99 at downgradient well 299-W19-31, with a level reaching 782 pCi/L in August 1996. The increase in technetium-99 in well 299-W19-31 corresponds to the change in groundwater flow back to an easterly direction and probably is related to that change.

200 Areas Liquid Effluent Disposal Facilities

216-A-10 and 216-A-36B Cribs. These deactivated cribs in the 200-East Area received liquid waste from the Plutonium-Uranium Extraction Plant. The waste stream at the 216-A-10 Crib was characteristically acidic and contained concentrated salts, hydrocarbon compounds, organic complexants, plutonium, uranium, and other radionuclides. The 216-A-36B Crib received ammonia scrubber distillate from nuclear fuel decladding operations, in which zirconium cladding was removed from irradiated fuel by boiling in a solution of ammonium fluoride and ammonium nitrate. Other waste stream constituents included cesium-137, cobalt-60, iodine-129, ruthenium-106, strontium-90, tritium, and uranium.

These cribs are in the indicator parameter phase of groundwater monitoring. Constituents including iodine-129, nitrate, strontium-90, and tritium were detected at levels that exceeded drinking water standards. However, the source of these groundwater contaminants is uncertain because they are present within large plumes in this area. Critical mean values were not exceeded for the indicator parameters (specific conductance, pH, total organic carbon, and total organic halogen) during 1996, except for one constituent at one monitoring well at the 216-A-36B Crib. Specific conductance exceeded the critical mean at well 299-E17-9 during May 1996. However, this well does not meet Resource Conservation and Recovery Act construction standards and is not used for statistical purposes. The elevated specific conductance is related to elevated nitrate concentrations.

216-A-29 Ditch. This is a deactivated earthen ditch approximately 2 km (1.2 mi) long that conveyed Plutonium-Uranium Extraction Plant chemical waste to the 216-B-3 Pond from 1955 to 1986. The ditch received effluents that contained dangerous chemical and radioactive contaminants. Of primary concern for Resource Conservation and Recovery Act regulations were discharges of sodium hydroxide and sulfuric acid, which occurred daily as a result of ion-exchange regeneration at the Plutonium-Uranium Extraction Plant.

In 1990, specific conductance increased beyond the critical mean and an assessment monitoring program was initiated. The assessment program confirmed that the ditch was the likely source of the elevated specific conductance. However, the constituents contributing to the high conductance were determined to be calcium, sodium, and sulfate, which are nonregulated substances. The groundwater monitoring program subsequently reverted to the indicator parameter monitoring phase, and specific conductance has been declining in both upgradient and downgradient wells at the site.

216-B-3 Pond. The 216-B-3 Pond (B Pond) is located immediately east of the 200-East Area and consists of a main pond and three expansion ponds (216-B-3A, 216-B-3B, and 216-B-3C). The main pond has been in use since 1945 and the expansions were built in the 1980s. Only the 216-B-3C section remains in operation. B Pond received liquid waste from B Plant and the Plutonium-Uranium Extraction Plant, consisting of chemical sewer waste, cooling water, and steam condensate. B Pond currently receives nondangerous, nonradioactive effluent primarily from the Plutonium-Uranium Extraction Plant and B Plant.

Groundwater monitoring at the B Pond system was changed to assessment level in 1990 because of elevated total organic halogen concentrations in downgradient wells 699-43-41E and 699-43-41F. Total organic halogen concentrations in these wells have generally declined since 1991. During 1996, 12 downgradient wells were sampled quarterly for semivolatile organic compounds that contribute to total organic halogen. No wells exceeded critical mean values for pH, specific conductance, or total organic carbon during 1996.

216-B-63 Trench. This trench, in service from March 1970 to February 1992, received liquid effluent from the B Plant chemical sewer, which consisted of a mixture of steam condensate and water. Past releases to the trench included aqueous sulfuric acid and sodium hydroxide solutions. Radioactive soils were dredged from the trench in August 1970 but no records exist of radioactive waste disposal to the trench.

Groundwater monitoring continues to provide no evidence that dangerous nonradioactive constituents from the site entered the groundwater from this trench. There were no exceedances in the indicator parameters of pH, specific conductance, total organic carbon, or total organic halogen.

216-U-12 Crib. This crib, located south of U Plant in the 200-West Area, received waste water containing both dangerous chemical wastes and radionuclides from April 1960 until February 1988. This facility is currently in the groundwater quality assessment phase of monitoring. Site-specific waste indicators include iodine-129, nitrate, technetium-99, tritium, total alpha, and total beta. Iodine-129, nitrate, technetium-99, and tritium are detected repeatedly and are being investigated to determine whether the crib is the source. Specific conductance has exceeded the 458-mS/cm critical mean in three downgradient wells (299-W22-41, 299-W22-42, and 699-36-70A) since groundwater monitoring began. Nitrate is the only constituent with consistently elevated concentrations in the downgradient wells and is the most significant contributor to the elevated specific conductance.

216-S-10 Pond and Ditch. This facility is located south-southwest of the 200-West Area, directly outside the perimeter fence. The facility consisted of an open, unlined ditch approximately 686 m (750 yd) long and an open, unlined percolation pond approximately 2.0 ha (4.9 acres) in size at the southwest end of the ditch. The ditch and pond received radioactive and dangerous chemical waste from the Reduction-Oxidation Plant from 1951 until 1985, when the pond and the lower part of the ditch were decommissioned and backfilled. The upper part of the ditch continued to receive nondangerous unregulated waste water after 1985.

The indicator parameters for this facility are specific conductance, field pH, total organic carbon, and total organic halogen. Field pH measured at well 299-W26-8 during 1996 was higher than the secondary drinking water standard, but was below the critical mean for this parameter. Chromium concentration was higher than the drinking water standard in upgradient well 299-W26-7, which suggests that the elevated chromium may be from upgradient sources rather than the 216-S-10 facility.

200 Areas Low-Level Burial Grounds

All low-level waste management areas at the Hanford Site are in the indicator-parameter phase of Resource Conservation and Recovery Act groundwater monitoring. A number of burial grounds are included within each low-level waste management area. Locations of the low-level waste management areas were shown in Figure 4.8.11.

Low-Level Waste Management Area-1. This waste management area consists of the 218-E-10 burial ground in the northwest corner of the 200-East Area. Disposal activities began in 1960 and continue to the present. Materials placed in this facility are primarily failed equipment and mixed industrial waste from the Plutonium-Uranium Extraction Plant, B Plant, and N Reactor. It is currently in the indicator parameter phase of groundwater monitoring.

Critical means for the contamination indicator parameters established for Low-Level Waste Management Area-1 were not exceeded during 1996. Although there is no evidence of any contaminant contribution from Low-Level Waste Management Area-1, contaminant plumes from other sources affect the groundwater quality.

Low-Level Waste Management Area-2. This waste management area is located in the northeast corner of the 200-East Area and includes all of burial ground 218-E-12B, which has been in use since 1968. The waste consists primarily of miscellaneous dry waste and submarine reactor compartments. Parts of two trenches contain transuranic waste.

Critical means for the contamination indicator parameters established for Low-Level Waste Management Area-2 were not exceeded during 1996. Values for iodine-129 were above the drinking water standard in several wells

along the southern boundary of Low-Level Waste Management Area-2. However, this is related to the widespread iodine-129 plume beneath the 200-East Area, and there is no evidence of contamination from Low-Level Waste Management Area-2.

Low-Level Waste Management Area-3. Burial grounds 218-W-3A, 218-W-3AE, and 218-W-5 make up Low-Level Waste Management Area-3, which is located in the north-central portion of the 200-West Area. These facilities cover 74.3 ha (181.4 acres). Burial ground 218-W-3A began accepting waste in 1970 and received primarily ion-exchange resins and failed equipment (e.g., tanks, pumps, ovens, agitators, heaters, hoods, jumpers, vehicles, and accessories). Burial ground 218-W-3AE began operation in 1981 and contains low-level and mixed waste, including rags, paper, rubber gloves, tools, and industrial waste. Burial ground 218-W-5 first received waste in 1986, and contains low-level and low-level-mixed waste, including lead bricks and shielding.

Carbon tetrachloride and nitrate are consistently above drinking water standards at Low-Level Waste Management Area-3 monitoring wells. However, the elevated values can be attributed to contaminant plumes originating to the south of Low-Level Waste Management Area-3. Trichloroethylene exceeded the 5-mg/L drinking water standard in upgradient wells 299-W10-19, 299-W10-20, and 299-W10-21. There appears to be no groundwater contamination directly attributable to Low-Level Waste Management Area-3, and there were no exceedances of the critical mean values for indicator parameters.

Low-Level Waste Management Area-4. This low-level waste management area consists of burial grounds 218-W-4B and 218-W-4C, which cover 24.4 ha (60 acres) in the south-central portion of the 200-West Area. Burial ground 218-W-4B first received waste in 1968 and contains mixed and retrievable transuranic waste in trenches and 12 caissons. One caisson is believed to contain mixed waste. Waste was first deposited in burial ground 218-W-4C in 1978. Transuranic, mixed, and low-level waste was placed in burial ground 218-W-4C, including contaminated soil, decommissioned equipment, and remote-handled transuranic waste.

There appears to be no groundwater contamination directly attributable to Low-Level Waste Management Area-4. Samples from downgradient wells did not exceed the critical means established for indicator parameters. Concentrations of carbon tetrachloride above drinking water standards were found in most wells in 1996. However, the source of the carbon tetrachloride is past disposal of liquid waste near the Plutonium Finishing Plant. Nitrate also exceeded the drinking water standard in several wells. The source of the contamination is the nitrate plume emanating from the vicinity of the Plutonium Finishing Plant.

Low-Level Waste Management Area-5. Low-Level Waste Management Area-5 was eliminated from further groundwater monitoring because no waste has been disposed to this facility and there are no plans for its use.

200 Areas Liquid Effluent Retention Facility

This facility consists of three lined surface impoundments (basins) located northeast of the 200-East Area and serves as temporary storage for condensate from the 242-A Evaporator. Constituents detected in the effluent stream from the 242-A Evaporator were acetone, aluminum, ammonium, 1-butanol, 2-butanone, cesium-137, ruthenium-106, strontium-90, and tritium.

Groundwater monitoring at this facility is in the indicator parameter monitoring phase. The indicator parameters are specific conductance, pH, total organic carbon, and total organic halogen. There were no exceedances of the critical mean values for these parameters, which indicates that no dangerous nonradioactive constituents have been released to groundwater.

300 Area Process Trenches

The site of the 316-5 Process Trenches is under the groundwater quality assessment stage of Resource Conservation and Recovery Act groundwater monitoring. These two unlined trenches were used for the disposal of most liquid wastes generated in the 300 Area beginning in 1975 and received uranium and other radioactive and chemical constituents. Uranium concentrations were higher than the drinking water standard at several wells near this facility in 1996.

Nonradioactive Dangerous Waste Landfill

The Nonradioactive Dangerous Waste Landfill is in the indicator parameter phase of groundwater monitoring. None of the indicator parameters of specific conductance, pH, total organic carbon, or total organic halogen exceeded critical mean values during 1996. Chlorinated hydrocarbons were detected in a few wells at concentrations below the drinking water standards.